CLAIMS

1.   A test chart used for analyzing geometric properties
regarding at least one of a recording device, a recording
medium, and an image pickup apparatus, comprising:

a recording medium having a recording face; and

a plurality of marks arrayed and recorded on the
recording face of the recording medium based upon a
predetermined geometric property format in a layout
structure which allows measurement of a predetermined
position of each mark through image processing, and at a
pitch which allows discrimination between each mark and
another marks through image processing.

2.   The test chart according to Claim 1, wherein the
predetermined geometric property format is designed giving
consideration to the geometric properties which are to be
analyzed.

3.   The test chart according to Claim 2, wherein the
number of the marks regulated based upon the predetermined
geometric property format is determined based upon the
precision of the recording positions of the marks and the
required precision of the geometric properties which are to
be analyzed.

4.   The test chart according to Claim 3, wherein the
predetermined geometric property format is designed such

that more marks are arrayed in the direction along which
recording is made with low positional precision in a case
wherein the recording positional precision of the marks is
dependent upon the recording direction.

5.   The test chart according to Claim 1, wherein the
plurality of marks are arrayed on the recording face at the
same intervals along at least one direction.

6.   The test chart according to Claim 1, wherein the same
number of marks are arrayed on the recording face along at
least one direction.

7.   The test chart according to Claim 1, wherein each mark
is formed of a single dot, or a plurality of dots arrayed
adjacent one to another so as to form a predetermined shape.

8.   The test chart according to Claim 1, wherein the test
chart comprises a plurality of chart components,

and wherein each chart component is formed of the
plurality of marks recorded on the recording face of the
recording medium according to the independent geometric
property format.

9.   The test chart according to Claim 8, wherein the
plurality of marks are recorded by a plurality of recording
means,

and wherein each chart component is recorded by the
corresponding recording means.

10.   The test chart according to Claim 8, wherein the

marks are recorded in a different form corresponding to the chart component.

11.   The test chart according to Claim 8, wherein the recording regions of one chart component and another chart component arrayed one to another form at least one overlapped region on the recording face of the recording medium.

12.   The test chart according to Claim 11, wherein the recording regions of the one chart component and another chart component arrayed one to another which form at least one overlapped region are formed of the marks in the same color.

13.   The test chart according to Claim 11, wherein the recording regions of the one chart component and another chart components arrayed one to another which form at least one overlapped region are formed of the marks in different colors.

14.   The test chart according to Claim 8, wherein the same number of marks between the chart components are recorded along a predetermined direction for each chart component, so as to configurate such that unintended deviations of the recording positions of the plurality of marks which are to be arrayed with uniformity along the direction orthogonal to the predetermined direction can be canceled out each other.

15.   The test chart according to Claim 1, wherein the

plurality of marks are arrayed with a predetermined average mark density so as to analyze the geometric properties without interference between the marks.

16. The test chart according to Claim 15, wherein the marks are recorded with the predetermined mark density of one mark per area where four marks can be recorded up to one mark per area where fifty marks can be recorded.

17. The test chart according to Claim 15, wherein the marks are recorded with the predetermined mark density of one mark per area where ten marks can be recorded up to one mark per area where twenty marks can be recorded.

18. The test chart according to Claim 1, wherein in a case that the susceptibility of the adjacent marks to interference therebetween exhibits directional dependence, the marks are arrayed at a smaller pitch along the direction orthogonal to the direction along which the adjacent marks exhibit the maximum susceptibility to interference therebetween than the pitch of the adjacent marks along the direction along which the adjacent marks exhibit maximum susceptibility to interference therebetween.

19. The test chart according to Claim 1, wherein the plurality of marks are recorded based upon at least two kinds of the geometric property formats by which unintended interference which can be generated during the geometric property analysis between the marks can be prevented in

advance.

20.   The test chart according to Claim 1, wherein the geometric property format is designed such that unintended interference which can be generated during the geometric property analysis between the marks can be prevented in advance.

21.   The test chart according to Claim 1, wherein the test chart further includes reference marks which are used for detecting the marks and which are recorded in a different form from the aforementioned marks.

22.   The test chart according to Claim 21, wherein at least three reference marks are provided so as not to be arrayed on a single line.

23.   The test chart according to Claim 1, further comprising: a bar formed of a plurality of dots in the shape of a belt for detecting substandard printing by the recording means with respect to the plurality of marks.

24.   A geometric property analyzing system for analyzing geometric properties regarding at least one of a recording device, a recording medium, and an image pickup apparatus, using the test chart according to Claim 1, comprises:

format storage means for storing the geometric property format;

image pickup means for optically reading the test chart and creating a chart image; and

analyzing means for determining at least one of a
reference point and a unit vector for determining the
predetermined positions of the plurality of marks in the
chart image such that the difference becomes minimum
between: the predetermined positions of the plurality of
marks in the chart image created by the image pickup means;
and the predetermined positions of the plurality of marks
based upon the geometric property format stored in the
format storage means.

25.   The geometric property analyzing system according to
Claim 24, wherein the analyzing means calculates the center
position of each mark as the aforementioned predetermined
position, and determines at least one of the reference point
and the unit vector in the chart image such that the sum of
squares of the aforementioned differences becomes minimum
between: the center positions of the plurality of marks in
the chart image; and the center positions of the plurality
of marks based upon the geometric property format.

26.   The geometric property analyzing system according to
Claim 24, wherein the analyzing means divide the test chart
into a plurality of chart components so as to perform
analysis for each chart component.

27.   The geometric property analyzing system according to
Claim 26, wherein the number of marks included in the chart
component is determined based upon: the precision of

detecting the position of the mark; and the required precision of the geometric properties which are to be analyzed.

28.   The geometric property analyzing system according to Claim 26, wherein the chart component is designed based upon: the geometric properties which are to be analyzed; and the required precision of the geometric properties.

29.   The geometric property analyzing system according to Claim 24, wherein the analyzing means divide the test chart into a plurality of chart components so as to perform relative comparison between the geometric properties of each chart component and the geometric properties of the other chart component serving as a reference, thereby enabling analysis of the geometric properties of each chart component.

30.   The geometric property analyzing system according to Claim 24, further comprising at least one recording means for recording the plurality of marks on the recording face of the recording medium.

31.   The geometric property analyzing system according to Claim 30, including the plurality of recording means, wherein the analyzing means divides the aforementioned plurality of marks into the chart components corresponding to the recording means for recording the marks, and determines at least one of the aforementioned reference point and unit vector for each chart component thus divided.

32. The geometric property analyzing system according to Claim 31, wherein each of the plurality of recording means records the marks in different forms,

and wherein the analyzing means group the marks based upon the form thereof, and forms a chart component for each group.

33. The geometric property analyzing system according to Claim 30, wherein the geometric property format is reconstructed based upon the analysis results analyzed by the analyzing means so as to perform recording on the recording face of the recording medium by the recording means.

34. The geometric property analyzing system according to Claim 30, wherein the geometric properties of the recording means are adjusted based upon the analysis results analyzed by the analyzing means.

35. The geometric property analyzing system according to Claim 34, wherein adjustment of the geometric properties of the recording means are made in order of: skew adjustment; density adjustment; and timing adjustment.

36. The geometric property analyzing system according to Claim 30, further comprising transporting means for transporting the recording medium relative to the recording means,

wherein the image pickup means is disposed on the

downstream side of the recording means along the
transporting direction determined by the transporting means,
and is formed of a line sensor for optically reading out the
test chart formed of the plurality of marks recorded by the
recording means.

37.   The geometric property analyzing system according to
Claim 30, wherein the recording means comprises an ink-jet
head for recording the plurality of marks on the recording
medium by discharging ink.

38.   The geometric property analyzing system according to
Claim 30, wherein the image pickup means is formed with
higher image pickup resolution than the recording resolution
of the recording means.

39.   The geometric property analyzing system according to
Claim 30, wherein the analyzing means is formed as a
separate unit from the recording means and the image pickup
means.

40.   The geometric property analyzing system according to
Claim 30, wherein the format storage means is integrally
held by the recording means, for storing the geometric
property format suitable for the recording means which
integrally holds the format storage means.

41.   The geometric property analyzing system according to
Claim 24, wherein the transporting belt for relatively
transporting the recording medium as to the image pickup

means is used as another recording medium,

and wherein the belt face of the transporting belt serves as the recording face,

and wherein a plurality of marks are recorded on the belt face so as to form a test chart on the belt face.

42.   The geometric property analyzing system according to Claim 41, wherein a plurality of openings formed on the belt face of the transporting belt serve as the plurality of marks,

and wherein suctioning means is further provided for fixing the recording medium on the belt face by air suctioning through the plurality of openings.

43.   The geometric property analyzing system according to Claim 24, wherein the geometric property format is designed giving consideration to the image size handled by the geometric property analyzing system.

44.   The geometric property analyzing system according to Claim 24, wherein the image pickup means analyzes the geometric properties based upon the geometric property format using a reference chart serving as a reference test chart in which the plurality of marks have been recorded with higher recording precision than the required analysis precision.

45.   The geometric property analyzing system according to Claim 44, further comprising at least one recording means

for recording the plurality of marks on the recording face
of the recording medium,

wherein the geometric properties of the image pickup
means are analyzed before analysis of the geometric
properties of the recording means,

and wherein the reference chart is recorded with higher
recording precision than the recording precision of the
recording means.

46. The printer employing the geometric property
analyzing system according to Claim 30.

47. The ink-jet printer employing the geometric property
analyzing system according to Claim 37.

48. A geometric property analyzing method for analyzing
the geometric properties regarding at least one of: a
recording device; a recording medium, and an image pickup
apparatus, using the test chart according to Claim 1,
comprising:

a format storing step for storing the geometric
property format;

an image picking-up step for optically reading out the
test chart and creating a chart image; and

an analyzing step for determining at least one of the
reference point and the unit vector for determining the
predetermined positions of the plurality of marks in the
chart image such that the difference becomes minimum between

the predetermined positions of the plurality of marks in the chart image formed in the image picking-up step and the predetermined positions of the plurality of marks based upon the geometric property format stored in the format storing step.

49. The test chart according to Claim 48, wherein the plurality of marks are recorded based upon at least two kinds of the geometric property formats which allow analysis of the geometric properties without unintended interference between the marks.

50. The geometric property analyzing method according to Claim 48, wherein in the analyzing step, the test chart is divided into a plurality of chart components, and relative comparison is made between the geometric properties of each chart component and the geometric properties of the chart component serving as a reference, thereby enabling analysis of the geometric properties of each chart component.

51. The geometric property analyzing method according to Claim 48, further including a recording step wherein at least one recording means records the plurality of marks on the recording face of the recording medium.

52. The geometric property analyzing method according to Claim 51, wherein the geometric properties of the recording means are adjusted based upon the analysis results obtained in the analyzing step.

53.   The geometric property analyzing method according to
Claim 52, wherein adjustment of the geometric properties of
the recording means is made in order of: skew adjustment;
density adjustment; and timing adjustment.

54.   The printer having a function for analyzing the
geometric properties using the geometric property analyzing
method according to Claim 48.

55.   The ink-jet printer having a function for analyzing
the geometric properties using the geometric property
analyzing method according to Claim 48.